National Bureau of Standards

TECHNICAL NEWS BULLETIN

MAY 1946 No. 349

Central Radio Propagation Laboratory

On May 1, the Bureau established its Central Radio Propagation Laboratory (Technical News Bulletin No. 344 (December 1945)) as a new major division in its scientific and technical group—Division XIV. All activities formerly conducted by the Radio Section of the Electricity Division have been transferred to the new division.

Although the Central Radio Propagation Laboratory will be responsible for all radio work in the Bureau, except the electronics work of the Ordnance Development Division, the emphasis will be on ionospheric research, as the name implies. For the past four years the Radio Section has operated the Interservice Radio Propagation Laboratory for the Joint Communications Board of the Joint Chiefs of Staff. This laboratory developed research methods for the study and forecasting of ionospheric conditions, based on data obtained from a chain of stations throughout the world. Some of these stations were operated by the Army and Navy, others by contract for the National Defense Research Committee.

The Bureau has been requested by the Joint Communications Board and other interested Government agencies to enlarge this activity. It will be carried on with advice and guidance of the Radio Propagation Executive Council, made up of representatives of interested Government agencies.

The new Division is made up of the following sections:

1. Basic Ionospheric Research.
2. Basis Microwave Research.
3. Regular Propagation Services.
4. Frequency Utilization Research.
5. Experimental Ionospheric Research.
6. Experimental Microwave Research.
7. Regular Propagation Measurements.
8. Ionospheric Measurement Standards.
9. Microwave Measurement Standards.

J. Howard Dellinger has been designated chief of the Central Radio Propagation Laboratory. Dr. Dellinger joined the Bureau's staff in 1907 and has headed the radio work since 1919. He received his Ph. D. from Princeton University in 1913 and the Sc. D. from George Washington University in 1932. He is a past-president of the Institute of Radio Engineers, and a recipient of its Medal of Honor. He has represented the United States at numerous international conferences on radio and telecommunications affairs.

Newbern Smith is designated as assistant chief of Division XIV. Dr. Smith received his Ph. D. from the University of Pennsylvania and has gained a world reputation for his work on determination of radio propagation conditions from ionosphere data.

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Specifications for Welded Ship Plates

In prewar days, small naval vessels were successfully fabricated by welding, but difficulties were encountered when attempts were made to use this procedure for the larger ships, built as cargo carriers during World War II. The fracture of certain strength members of an all-welded merchant vessel in service led to the appointment, in January 1943, of a Navy Board of Investigation to inquire into the design and methods of construction of welded steel merchant vessels. The cooperation of the Bureau's metallurgical laboratories was requested to determine whether the failures were the result of inadequate design, improper welding, or defective ship plate. Prior to March 1946, when the Board of Investigation ceased to function, samples of plates from 45 fractured vessels had been examined by the Bureau.

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The investigation had two primary objects: (1) to determine why the cracks started; and (2) to find why the cracks, once started, might or might not progress almost instantaneously all the way around the vessel. Defective design and defective welding were evident causes of some of the failures, particularly those noted in the early stages of the investigation, and measures were taken to correct the design and to provide closer supervision and inspection of the welding operation. However, in many cases the design was adequate and the welding was satisfactory, but cracks still appeared and sometimes were long and serious. In no case was the steel defective, according to the usual specifications, inspection, and acceptance tests. The only property of the steels that appeared to be directly related to the ready propagation of cracks was the Charpy impact value; plates in which the fracture originated and progressed were notch sensitive, i. e., had low impact values, whereas plates in which the fracture stopped were not notch-sensitive. Proper design and proper welding should minimize the occurrence of cracks, and the use of steel that is not notch-sensitive should prevent the propagation of the few cracks that will form in spite of all reasonable precautions.

Specifications for ship plate in the past have not included a determination of notch sensitivity, but such a determination has been recommended for inclusion in future specifications for assemblies containing structural or geometric notches and residual stresses of high or unknown magnitude.

New Circular on Underground Corrosion

Circular C450 by Kirk H. Logan, released last month, is an assembly of results of the Bureau's investigations of underground corrosion that began in 1922. The fundamental causes and processes of underground corrosion are the same as those associated with air and water, but their relative values are different. Corrosion in soils is, necessarily, the result of soil characteristics and conditions, but these are so numerous and complex that it is impossible to correlate corrosion with any single soil property.

The results of tests given in this Circular indicate that ferrous materials in common use do not differ greatly in their resistance to soils and that apparent relative merits are either accidental or dependent on local conditions. Low-alloy ferrous materials lose weight more slowly than those that are unalloyed, but they are penetrated just as rapidly. Alloys high in nickel and chromium are very resistant to corrosion.

In most of the soils included in these investigations, the rate of corrosion decreased as the exposure was prolonged. Any corrosion rate is applicable only to the area of metal tested and to the actual period during which it was exposed. The life of a pipe can not, therefore, be predicted solely from the loss in weight or the depth of a pit as determined over a single period. The corrosiveness of a soil can be indicated only by a formula that takes account of the characteristics of the soil, the change in rate of corrosion with time, and the area of the exposed metal.

The data in the Circular show that copper, and alloys high in copper, corrode much less and more uniformly than ferrous materials. Lead, although resistant to many soils, pits deeply in some of them.

The effectiveness of metallic coatings depends on the soils to which they are exposed; no one of them is suitable for all soils. Bituminous coatings greatly retard loss of metal, their effectiveness being roughly proportional to their thickness. Unfortunately, very few

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U. S. Department of Commerce
Henry A. Wallace, *Secretary*

National Bureau of Standards
E. U. Condon, *Director*

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Contents

of these coatings are entirely free from pin holes and other imperfections. In this connection, important causes of failure are improper application and injuries received while laying the pipe. . Better tools and methods have reduced the failures from these causes, but it is still difficult to secure a completely protected pipe, and even after the pipe is in place, the coating may be injured by soil stress and the roots of trees, shrubs, and grass. The results of tests on a number of promising coatings, developed in the laboratory, are presented.

Several procedures for testing soils and coatings are described, and corrosion prevention methods are compared. Cathodic protection is shown to retard or prevent corrosion under most soil conditions (Technical News Bulletin No. 313, May 1943). Methods of applying cathodic protection are briefly described.

Six appendices give details of test methods and apparatus that are referred to in the body of the text.

Copies of C450, bound in blue buckram, are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at $1.25 each.

Fire Resistance of Heavy Timber Construction

Although heavy timber or "mill" construction floors have withstood fires better than lighter unprotected wood construction, no information has been available on how long they withstand fires of the severity used in the standard furnace test. Experiments recently concluded at the Bureau under the direction of S. H. Ingberg show that the limit of resistance of such floors, with the lower face exposed to fire, is determined either by failure under representative working loads or by occurrence of flame or ignition of combustible material on the upper side.

With a 1-inch finish floor on top, the fire resistance of laminated floors of 4-inch planks on edge averaged 45 minutes; with 6-inch planks, a little over 1 hour; and with 8-inch planks, about 1½ hours. With the structural portion of the floor of tongued and grooved plank of 3-inch nominal thickness laid flatwise, the fire resistance was approximately 45 minutes. Impregnation of the wood with fire-retarding chemicals increased the fire resistance of 4-inch floors by about 15 minutes. A comparable increase was obtained with a heavy coating of a fire-retarding compound on the lower surface.

Effects of Fuel Distribution on Engine Performance

In the course of the Bureau's investigation of substitute motor fuels, conducted at the request of the Foreign Economic Administration, measurements were made by Donald B. Brooks of the actual mixture distribution to the cylinders of automotive engines. It was desired to compare the observed performance under known conditions of distribution with values calculated from performance under conditions of very good distribution.

In a single-cylinder engine, the "distribution" inherently is perfect. An empirical equation, accordingly, was fitted to extensive performance data obtained in a single-cylinder test engine. By suitable transformations, this equation could be used to compute performance data for a multi-cylinder engine having any chosen mixture distribution. Calculations have been made for a number of typical instances. The results, which will be published as RP1712 in the May Journal of Research, show how the relations of power and specific fuel consumption to rate of fuel flow are altered by changes in distribution. It is demonstrated that minimum specific fuel consumption is a good criterion of distribution, an improvement in this variable being generally accompanied by improvement in the other phases of engine performance. A method has also been developed for ascertaining the improvement over a given distribution that would result from perfecting the manifolding.

Heats of Combustion and Formation of Hydrocarbons

In the May number of the Journal of Research (RP1714), Edward J. Prosen, Walter H. Johnson, and Frederick D. Rossini present a report on the heats of combustion and formation of the alkylbenzene hydrocarbons.

Values are given for the heats of combustion (in oxygen to form gaseous carbon dioxide and liquid water) and the heats of formation (from the elements, solid carbon (graphite) and gaseous hydrogen), at 25° C, for benzene, toluene, the four C_8H_{10}, the eight C_9H_{12}, and the 22 $C_{10}H_{14}$ alkylbenzenes, in both the liquid and gaseous states, and for the higher normal monoalkylbenzenes in the gaseous state.

Heats of Combustion of Cyclopentane and Cyclohexane Hydrocarbons

Results of a thermochemical investigation of four cyclopentane and five cyclohexane hydrocarbons by Walter H. Johnson, Edward J. Prosen, and Frederick D. Rossini are presented in RP1715 in the May Journal of Research.

The heats of combustion of cyclopentane, methylcyclopentane, ethylcyclopentane, *n*-propylcyclopentane, cyclohexane, methylcyclohexane, ethylcyclohexane, *n*-propylcyclohexane, and *n*-butylcyclohexane were measured with a bomb calorimeter. The following values were obtained for $-\Delta Hc°_{298.16}$, the heat of combustion at 25° C and constant pressure of the liquid hydrocarbon in gaseous oxygen to form gaseous carbon dioxide and liquid water. All the reactants and prod-

ucts are in their thermodynamic standard reference states, and the values are expressed in international kilojoules per mole, with the corresponding values in terms of the conventional thermochemical calorie given in parentheses:

Cyclopentane	3290.34±0.72	(786.54±0.17).
Methylcyclopentane	3937.07±0.75	(941.14±0.18).
Ethylcyclopentane	4591.17±0.94	(1097.50±0.22).
n-Propylcyclopentane	5244.75±1.18	(1253.74±0.28).
Cyclohexane	3919.26±0.70	(936.88±0.17).
Methylcyclohexane	4564.52±0.95	(1091.13±0.23).
Ethylcyclohexane	5221.71±1.46	(1248.23±0.35).
n-Propylcyclohexane	5874.79±1.15	(1404.34±0.27).
n-Butylcyclohexane	6529.21±1.22	(1560.78±0.29).

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Thermodynamic Properties of Monoolefin and Aromatic Hydrocarbons

Three related papers, by Mary A. Greaney, Walter H. Johnson, John E. Kilpatrick, Edward J. Prosen, William J. Taylor, Donald D. Wagman, Kenneth S. Pitzer, and Frederick D. Rossini, were presented at the April meeting of the American Chemical Society, as part of the work of the thermochemical laboratory and the American Petroleum Institute Research Project 44 at the Bureau. These papers give chemical thermodynamic properties for (1) all the normal 1-alkene monoolefin hydrocarbons and the isomeric monoolefins through the hexenes, and (2) all the normal alkylbenzenes and the isomeric aromatic hydrocarbons, through C_9H_{12}.

The properties for which values are given, from 0° to 1,500° absolute, include heat content or enthalpy, heat capacity, free-energy function, entropy, heat of formation, free energy of formation, and equilibrium constant of formation.

Values are given for the following compounds, along with many others:

Benzene, toluene, and each of the three xylenes. These are important constitutents of petroleum and also of coal tar. They have important industrial uses as solvents, and in the manufacture of explosives. Orthoxylene is used in a new process for making phthalic anhydride.

Ethylbenzene, one of the important components in the manufacture of standard government synthetic rubber.

Isopropylbenzene, or cumene, which was important as a component of military aviation fuel during the war.

Ethylene, propylene, and each of the four butenes. These are important components of refinery gases; they are being utilized in the production of many new chemicals.

Isobutene, the main component in the production of butyl rubber.

Together with other data, these new values will permit better control and greater economy of operation of the chemical manufacturing and petroleum refining processes in which monoolefin and aromatic hydrocarbons are used in the petroleum, chemical, and rubber industries.

Energy Content and Molecular Structure of Hydrocarbons

At the April meeting of the American Chemical Society, Frederick D. Rossini summarized the results of 15 years' work at the Bureau on the thermochemistry of the simpler hydrocarbons. His report described the relations existing between energy content and structure for hydrocarbons of the following classes: Paraffins, olefins, acetylenes, aromatics, cyclopentanes, and cyclohexanes. Energy is one of the most important properties of matter, and its efficient utilization in manufacturing and refining requires adequate knowledge of the fundamental values of the compounds involved in the given processes.

High-Efficiency Laboratory Distilling Columns

A report on distilling columns of high efficiency was presented before the division of petroleum chemistry of the American Chemical Society at a meeting on April 9, by Charles B. Willingham and Frederick D. Rossini. The report includes a description of the assembly, testing, and operation of the columns used at the Bureau in the work of American Petroleum Institute's Research Project 6 on analysis and purification of hydrocarbons and in the preparation of standard samples. The following topics were covered: Assembly of distilling columns, including pot, rectifying section, jacket, head, reflux regulator, receiving assembly, electrical heating system, thermometric systems, and controlled-pressure system; testing, including test mixtures and results; and operation, for both regular and azeotropic distillations. These distilling columns have charging capacities up to 4 gallons and separating efficiencies up to 200 theoretical plates, at total reflux. The distilling operations are performed continuously, 24 hours a day, 7 days a week. Reflux ratios range from 125/1 up to 180/1, with rates of removal of product ranging from 2 to 12.5 ml of liquid an hour. The total time of distilling given charges may be as long as 1,800 hours.

Effects of Mildew on Leather

Mildew-growth on leather is a very common occurence in the tropics, and accordingly the war in the South Pacific created an unusual interest in the subject. Considerable information on general observations of mold growth on hides, leather, and leather-making materials may be found in the literature. However, no data on the actual damaging effects of these microorganisms have been available. For this reason a study of the effects of mold on leather was undertaken by Joseph R. Kanagy, Arbelia Mae Charles, Edward Abrams, and R. F. Tener of the Bureau. In the May Journal of Research (RP1713), the results are given for tests conducted with vegetable-tanned strap leather.

This study was made on leathers with and without fungicidal protection, exposed under controlled conditions varying from mild to severe, when judged on the basis of the rate of growth of mildew. Some leathers were buried in soil; others were placed in a room under tropical conditions; and a few were subjected to mildew growth in a humidity cabinet. The leathers were exposed for as long as 12 weeks. Tests were made after 4, 8, and 12 weeks of exposure. All leathers without fungicidal protection continued to support the growth of mildew so long as they were exposed to these conditions.

The results of the tests give evidence that the growth of mildew on leather is supported by the oils and greases which act as a nutrient. Tests on the oils show a decrease in the saponification numbers. This indicates that the microorganisms attack the fatty acids at the carboxyl group, and decarboxylation apparently occurs.

Physical tests demonstrated that growth of mildew on leather increased stiffness, gave a loss in tensile strength, and decreased stretch at the breaking point. It also weakened the grain surface.

Determinations of soluble nitrogenous matter in the exposed leathers (by sodium carbonate extraction) showed that there was no appreciable deterioration of hide substance. Some results also indicate that the tensile strength for individual specimens does not fall below a definite minimum value. This again indicates that there was no breakdown of the basic structure of the hide substance as a result of mildew growth.

A fungicidal preparation having paranitrophenol and pentachlorophenol as the active fungicides gave excellent protection against mildew for 12 weeks. The leathers contained a total of 0.85 to 0.90 percent of the two fungicides based on the weight of the leathers.

Wartime Work on Packaging Materials

In an article prepared for publication in Domestic Commerce, B. W. Scribner gives a résumé of the Bureau's work on packaging materials during World War II.

It became necessary during this period to find what critical packaging materials could be dispensed with, to develop paper substitutes for the critical products, and to develop new or improved specifications and testing methods to insure better performance. These objectives were achieved through cooperative work with the war agencies and manufacturers.

Cellophane of the waterproofed type and metal foil are excellent moisture barriers for such a variety of purposes that it became necessary to restrict their use to essential kinds of packaging. Study of their relative efficacy as a moisture barrier when used to wrap cigarettes revealed that with the foil unsealed, as in cigarette packages, the cellophane was the primary barrier and that the foil could be omitted without undue transfer of moisture through the packaging materials.

Extensive tests of asphalted wrapping papers resulted in an improved Federal specification for papers to be used for general packaging purposes, and in a recommended specification for papers for lining shipping cases. In the latter development an improved cabinet for testing water vapor permeability at high temperature and humidity was devised. Information was also obtained on the deterioration of caselining papers caused by mildewing.

The greatly increased use of paper shipping sacks brought about by the necessity for conserving metal, wood, and textile containers necessitated the development of a Federal specification for the sacks. This was the first comprehensive standardization of them.

Through cooperative testing with manufacturers, substitutes were developed for the critical cloth, metal, and abaca manila hemp fibers used in the manufacture of shipping tags. Paper tags having greatly increased durbility secured by the use of melamine resin, served as a satisfactory substitute for cloth tags.

The Bureau assisted in the development of specifications for gummed sealing tape used to seal fiber containers and shipping sacks. These cover two types of tape, one with water-soluble gum and the other with water-resistant gum.

Paint Pigment Standards

Two new dry paint pigments have been added to the Bureau's set of standard samples for color and tinting strength (Technical News Bulletin No. 331 (November 1944)), making 26 that are now available. The new ones are NBS No. 324, Ultramarine Blue, Federal Specification TT–U–450; and NBS No. 325, Iron Blue, Federal Specification TT–I–677. The price is the same as heretofore—$2.00 per sample, payable in adance. Money orders, etc. should be payable to the National Bureau of Standards. Copies of the Federal Specifications that correspond with the standards are obtainable from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at 5 cents each.

Size Grading of Diamond Powders

At the beginning of the war it was found that this country was short of high quality diamond powder. An investigation was, therefore, undertaken at the Bureau at the request of the War Production Board to supply information on methods of grading. B. S. Steierman, Herbert Insley, and W. H. Parsons, who were assigned to this project, investigated 30 liquids to determine their dispersing action with diamond powder. Gelatin solution was found the most suitable of these liquids. Various methods of size grading were tried and discussed. The Cooke short-column elutriator was found to work satisfactorily and to be able to size large quantities of powder with little attention. The results of the work will be published as RP1716 in the May Journal of Research. Problems in connection with sizing are discussed, and photomicrographs of the results of the diamond powder sizing are presented.

Precision of Telescope Pointing for Outdoor Targets

When a telescope is pointed at a target, and the intersection point of the cross hairs is set on the image formed by the objective and seen through the ocular, accidental (nonsystematic) errors are present that prevent the observer from reproducing exactly the same pointing in successive settings. These errors may be attributed in part to the mechanism employed in pointing the telescope, and in part to errors dependent upon the combination of target nature, optical path, optical characteristics of the telescope, and personal errors. A recent study by Francis E. Washer and Helen B. Williams has been concerned with determining the probable error of a single pointing under average outdoor conditions when the errors arising from the mechanism are eliminated. To accomplish this the telescope was mounted rigidly and left undisturbed during the course of a series of observations. The image of the target was moved with respect to the cross hairs by means of a weak prism, placed in front of the objective, which was capable of rotation about its vertical axis. With this apparatus, the probable error of a single pointing was measured for a group of outdoor targets placed at distances ranging from 100 to 13,600 meters from the observer. Observer differences for both outdoor and indoor targets were studied.

In the course of the investigation, it was found that, when distance is neglected, the probable error of a single pointing is ± 0.62 second of arc. Although, for practical purposes, distance can be neglected, when it is over 100 meters, it is interesting to note that the formula,

$$PE_s = \pm (0.064 d^{1/4} + 0.19) \text{ second},$$

where d is the range in meters and PE_s is the probable error of a single pointing, gives fair agreement with the measured values of PE_s. Differences were found for right- and left-eye pointing for six observers. In addition, the precision of outdoor pointing was affected by long-period errors that cause the mean value to shift during the course of an extended series of observations. The complete report on this study will be published as RP1717 in the May number of the Journal of Research.

Radio Propagation Disturbance Warning

The note "Ionosphere Disturbance Warnings" on page 20 Technical News Bulletin No. 347 (March 1946) contains an error. At the end of the paragraph the letter should be "N", not "W". Likewise, this note did not state the times when the warnings are given. They are broadcast from the Bureau's station WWV following the time announcements at 20 and 50 minutes past each hour. A series of "W's" means warning of disturbance; a series of "N's" means normal conditions. This information is of immediate importance to those concerned with radio propagation problems, particularly over northern transmission paths.

A more complete explanation of this new service is included in a recent announcement of the technical radio broadcast services of the Bureau, obtainable upon request.

Robert Simha Receives Award of Washington Academy of Sciences

Robert Simha, who joined the staff of the Bureau's Organic and Fibrous Materials Division last summer, received on March 21 the 1945 award of the Washington Academy of Sciences for distinguished service in the physical sciences. The award was made in recognition of Dr. Simha's work on the physical chemistry of high polymers, including rubbers, plastics, fibers, and similar materials. The work has resulted in more than a score of papers dealing with the theories of viscosity, elasticity and flow, and the kinetics of polymerization. Before Dr. Simha came to the Bureau, he was engaged in teaching and research at Howard University, the Polytechnic Institute of Brooklyn, Columbia University, and the University of Vienna.

New and Revised Publications Issued During April 1946

Journal of Research [1]

Journal of Research of the National Bureau of Standards, volume 36, number 2, February 1946 (RP1693 to RP1699, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Research Papers [1]

(Reprints from December 1945 and January 1946 Journal of Research)

RP1681. Utilization of nonpetroleum fuels in automotive engines. Jesse T. Duck and Clarence S. Bruce. Price 10 cents.

RP1682. Heats, equilibrium constants, and free energies of formation of the acetylene hydrocarbons through the pentynes, to 1500° K. Donald D. Wagman, John E. Kilpatrick, Kenneth S. Pitzer, and Frederick D. Rossini. Price 10 cents.

RP1683. Reaction of periodic acid on the difructose anhydrides. Emma J. McDonald and Richard F. Jackson. Price 5 cents.

RP1684. Thermodynamic properties of solid and liquid ethylbenezene from 0° to 300° K. Russell B. Scott and Ferdinand G. Brickwedde. Price 5 cents.

RP1685. Assembly and calibration of a density balance for liquid hydrocarbons. Alphonse F. Forziati, Beveridge J. Mair, and Frederick D. Rossini. Price 5 cents.

RP1686. Ultraviolet spectra and dissociation constants of *p*-hydroxybenzoic acid, methyl, ethyl, *n*-butyl and benzyl *p*-hydroxybenzoate and potassium *p*-phenolsulfonate. Elizabeth E. Sager, Marjorie R. Schooley, Alice S. Carr, and S. F. Acree. Price 10 cents.

RP1687. First dissociation constant of *o*-phthalic acid and related pH values of phthalate buffers from 0° to 60° C. Walter J. Hamer, Gladys D. Pinching and S. F. Acree. Price 10 cents.

RP1688. Specification of railroad signal colors and glasses. Kasson S. Gibson, Geraldine Walker Haupt, and Harry J. Keegan. Price 10 cents.

RP1689. Attack on refractory clay pots by optical glasses. Willard H. Parsons and Herbert Insley. Price 10 cents.

RP1690. pH standards at various temperatures: Aqueous solutions of acid potassium phthalate. Walter J. Hamer, Gladys D. Pinching, and S. F. Acree. Price 5 cents.

RP1691. Extraction of alumina from clays and high-silica bauxites. E. P. Flint, W. F. Clarke, E. S. Newman, Leo Shartsis, D. L. Bishop, and Lansing S. Wells. Price 10 cents.

RP1692. Stability of double-walled manganin resistors. James L. Thomas. Price 5 cents.

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, $3.50 per year (to addresses in the United States and its possessions and to countries extending the franking privilege); other countries, 70 cents and $4.50; respectively.

Circular [1]

C450. Underground corrosion. Kirk H. Logan. 312 pages, bound in blue buckram. Price $1.25.

Commercial Standard [1]

CS130–46. Color materials for art education in schools. Price 10 cents.

Technical News Bulletin [1]

Technical News Bulletin 348, April 1946. Price 5 cents. Annual subscription, 50 cents.

Mimeographed Material

Letter Circulars

(Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.)

LC819. National Bureau of Standards specification for Knoop indenters.

LC820. Plastic paint. (Supersedes LC798.)

LC822. Specification for proving rings for calibrating testing machines. (Supersedes LC657.)

LC823. List of Commercial Standards. (Supersedes LC815.)

Recent Articles by Members of the Bureau's Staff Published in Outside Journals [2]

Wisdom is better than weapons of war. E. U. Condon. Atomic Information (1621 K St., N. W., Washington 6, D. C.) **1**, No. 2, 6 (March 25, 1946).

Painting steel. Wilbur C. Porter. Journal of Property Management (22 West Monroe St., Chicago 3, Ill.) **11**, No. 2, 109 (December 1945).

The textile research of the A. A. T. C. C. William D. Appel. Research program of the American Association of Textile Chemists and Colorists, (Lowell Textile Institute, Lowell, Mass.) p. 1 (February 1946).

The slip casting of clay pots for the manufacture of optical glass at the National Bureau of Standards. Raymond A. Heindl, Gordon B. Massengale, and Louis G. Cossette. Glass Industry (55 West 42d St., New York, 18, N. Y.) **27**, No. 4,177 (April 1946).

[2] These publications are not obtainable from the Government. Requests should be sent direct to the publishers.

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